We claim:

1. An improved method for presenting pyrolytic oil-productivity index (POPI) data for characterizing reservoir rock from different geological regions A and B, the method comprising:

a) providing a $POPI_{o(A)}$ value for the region A;

b) calculating the value for a normalizing factor $F_{NORM(A)}$ for the region A in accordance with equation (2A):

$$F_{NORM(A)} = \frac{100}{POPI_{o(A)}} \; ; \tag{2A}$$

c) applying the normalizing factor for a given reservoir rock sample "a" from the region A in accordance with the following equation (3A):

$$F_{NORM(A)} \times POPI_{(a)} = POPI_{NORM(A)(a)} \; ; \tag{3A}$$

d) recording the value of $POPI_{NORM(A)(a)}$;

e) providing a $POPI_{o(B)}$ value for the region B;

f) calculating the value for a normalizing factor $F_{NORM(B)}$ for region B in accordance with equation (2B):

$$F_{NORM(B)} = \frac{100}{POPI_{o(B)}} \; ; \tag{2B}$$

g) applying the normalizing factor for a given reservoir rock sample "a" from the region B in accordance with the following equation ($3A^1$):

$$F_{NORM(B)} \times POPI_{(a)} = POPI_{NORM(B)(a)} \; ; \text{ and} \tag{3A^1}$$

h) recording the value of $POPI_{NORM(B)(a)}$,

whereby the values of $POPI_{NORM(A)(a)}$ and $POPI_{NORM(B)(a)}$ are directly comparable to determine the relative quality of the reservoir rock in the regions A and B.

2. The method of claim 1 where the normalization factors $F_{NORM(A)}$ and $F_{NORM(B)}$ are applied to a plurality of values $POPI_{(A)(X)}$ and $POPI_{(B)(X)}$ associated with a corresponding plurality of reservoir rock samples "x" obtained from regions A and B, whereby the POPI data so normalized is directly comparable to determine the relative quality of the corresponding reservoir rock samples from regions A and B.

3. The method of claim 1 where the POPI data are recorded in an electronic data storage device associated with a general purpose computer.

4. The method of claim 3 where the values of $POPI_{o(A)}$ and $POPI_{o(B)}$ are provided by accessing the data storage device.

5. The method of claim 4 where the general purpose computer is programmed to calculate the normalizing factors for each of the plurality of datum from the regions A and B, to apply the normalizing factors for each of the plurality of POPI datum selected for each of the regions A and B and to transfer normalized data to the data storage device.

6. The method of claim 1 where the value of $POPI_{o(A)}$ or $POPI_{o(B)}$, or both, is calculated in accordance with equation (7):

$$\mathrm{POPI_o} = \mathrm{PPLC} \times \ln(\mathrm{HC_{min}}), \qquad (7)$$

where PPLC is the POPI Pre-Logarithmic Coefficient and is a constant for a given type of oil;

ln is the natural logarithm; and HC_{min} is assigned a value in the range of 4 to 6 mg HC/gram of rock; and

the value of PPLC is determined by utilizing a logarithmic fit of POPI and (LV + TD + TC) data points for a plurality of rock samples in accordance with equation (5):

$$\mathrm{POPI} = \mathrm{PPLC} \times \ln(\mathrm{LV} + \mathrm{TD} + \mathrm{TC}) \qquad (5)$$

where (LV + TD + TC) is the total quantity of hydrocarbons in a sample.

7. The method of claim 1 where the value of $POPI_{o(A)}$ or $POPI_{o(B)}$, or both, is calculated in accordance with equation (7):

$$\mathrm{POPI_o} = \mathrm{PPLC} \times \ln(\mathrm{HC_{min}}), \qquad (7)$$

where the terms are as defined above, and the value of PPLC is calculated in accordance with equation (6A):

$$\mathrm{PPLC} = 0.151 \times e^{(0.0976\mathrm{API})} \qquad (6A)$$

where API is the numerical value of the API gravity.

8. The method of claim 1 where the value of $POPI_{o(A)}$ or $POPI_{o(B)}$, or both, is calculated in accordance with equation (6C):

$$\mathrm{API} = \frac{\ln(\mathrm{PPLC}/0.151)}{0.0970} \qquad (6C)$$

9. A method of normalizing data derived by application of the POPI method to a plurality of sets of reservoir rock samples X_n obtained from a plurality of geophysical regions A_n, the data comprising a single value of $POPI_0$ derived for each of the plurality of regions A_n and a set of values of $POPI_X$ for the rock samples X_n obtained from each region, the method comprising the steps of:

a) calculating the value for a normalizing factor $F_{NORM(A)}$ for each of the regions A_n in accordance with

$$F_{NORM(A)} = \frac{100}{POPI_{o(A)}} \ ;$$

b) applying the normalizing factor in accordance with the following

$$F_{NORM(A)} \times POPI_{o(A)} = POPI_{NORM(A)} \ ;$$

c) applying the normalizing factor to each value in the data set comprising the set for the corresponding region in accordance with:

$$F_{NORM(A)} \times POPI_{X(A)} = POPI_{NORM(XA)} \ ; \text{ and}$$

d) recording the data resulting from steps (b) and (c) above.

10. A method for estimating the API gravity value of oil contained in reservoir rock proximate a well bore hole X_n located in region A, where the region A has produced oil at a plurality of different locations exhibiting different known API gravity values, the method comprising the steps of:

a) recording data sets corresponding to the POPI values and the Total Hydrocarbons (LV + TD + TC) for each of the oils having a different known API gravity and for the well X_n;

b) fitting a separate logarithmic curve to each of the separate data sets recorded in step (a) in accordance with formula (4):

$$POPI = PPLC \times \ln(LV+TD+TC)+b$$

c) preparing a graphic plot of the PPLC value versus the API gravity for each of the oils having a different known API gravity;

d) locating the position on the graphic plot for the PPLC value associated with the data set of well X_n;

e) identifying the API gravity value for well X_n corresponding to the PPLC from the graphic plot; and

f) recording the estimated API gravity as identified in step(e) for the oil in the reservoir rock proximate well X_n.

11. The method of claim 10 where the data are recorded in an electronic memory device associated with a programmable computer, said computer being provided with a program adapted to perform steps (b) through (f); the method further comprising operating said programmed computer to perform steps (b) through (f) and displaying the API gravity value as recorded in step (f) on display means.

12. The method of claim 11 where the display means are selected from the group consisting of a monitor associated with the computer and printed paper record.

13. A method of estimating the API gravity value of oil contained in reservoir rock from an oil field region A based on the pyrolytic oil-producing index, POPI, of good quality reservoir rock in the region A, the method comprising the steps

a) providing a set of POPI data;

b) preparing a plot of the POPI values versus total hydrocarbons (LV + TD + TC);

c) fitting a logarithmic curve to the plot of step (b) by application of a POPI Pre-logarithmic Coefficient, PPLC, having an empirically-determined numerical value;

d) solving the following equation (9) for API gravity:

$$POPI_0 = PPLC \times \ln(577 \times API^{-1.38}),$$

where $POPI_0$ is the value for good quality reservoir rock and PPLC is determined in accordance with step (c), above, and

e) recording the value of API gravity.

14. A method of estimating the API gravity value for oil contained in reservoir rock proximate a well bore hole X_n located in a region A, where the region A has produced oil exhibiting a plurality of different known API gravity values, the method comprising the steps of:

a) providing a separate graphical plot of POPI values versus Total Hydrocarbons (LV + TD + TC) for each of the plurality of oils having a different known API gravity, all of said plots being to the same scale;

b) fitting a logarithmic curve to each of the separate graphic plots provided in step (a) in accordance with the equation (5):

$$POPI_{oil} = PPLC \times \ln(LV+TD+TC); \quad (5)$$

c) preparing a plot of PPLC versus API gravity for the set of oils fitting an exponential curve to the data in accordance with equation (6):

$$PPLC = PEC \times e^{(c \times API)} \quad (6)$$

d) preparing a plot of POPI versus Total Hydrocarbons (LV + TD + TC) from rock samples obtained from well bore hole X_n, said plot being to the same scale as the plurality of plots prepared in step (b);

e) fitting a logarithmic curve to the graphic plot prepared in step (d) in accordance with equation (5);

$$POPI_{oil} = PPLC \times \ln(LV + TD + TC) \quad (5)$$

f) comparing the PPLC determined from rock samples with the plot of PPLC versus API gravity of oil samples to determine the approximate of API gravity of oil in the reservoir rock; and

g) recording the estimated value of the API gravity of oil proximate well bore hole X_n.

15. The method of claim 14 where the POPI values for the plurality of oils of known API gravity are derived from core samples.

16. The method of claim 15 where the core samples are not specially preserved.

17. The method of claim 14 which comprises the further steps of entering the POPI values and Total Hydrocarbon values in the memory of a programmable computer that has been programmed to calculate the value of PPLC for each of the plurality of oils having a known API gravity and for the samples from well X_n.

18. The method claim 17 which further comprises directing the computer to compare the data and display the API gravity value or values that correspond to the PPLC for well X_n.

19. The method of claim 18 where the data displayed comprises a graphic plot of POPI values versus Total Hydrocarbons for the well X_n and for at least the one closest oil of known API gravity.

20. An improved method for characterizing reservoir rock from an oil well bore hole based on a set of conventional water saturation values for a given length of the bore hole over an interval L as calculated from the Archie Equation, the improvement characterized by:

a) providing a plurality of reservoir rock samples "a" taken from known positions along the interval L;

b) calculating the value of the pyrolytic oil productivity index ($POPI_a$) for each of the rock samples "a" in accordance with equation (1a):

$$POPI_a = \ln(LV_a + TDa + TC_a) \times (TDa \div TC_a) \qquad (1a)$$

c) recording the calculated $POPI_a$ values in a data set in conjunction with the position of the sample along the interval L;

d) providing the value of PPLC by:

(i) plotting POPI versus (LV+TD+TC) and obtaining a logarithmic fit of the data, or

(ii) plotting POPI versus (LV + TD + TC) and iteratively fitting a logarithmic line of the equation $POPI_{oil} = PPLC \times \ln(LV + TD + TC)$ by varying the value of PPLC until most of the data fit

within the region between the line describing $POPI = POPI_{oil}$ and the X-axis ($POPI = 0$);

(iii) utilizing the known relationship between API gravity in a region and the PPLC to solve for the PPLC using a value selected from the expected or actual API gravity for oil produced from a well.

(e) calculating and recording $POPL_{oil}$ values for each reservoir rock sample "a" in accordance with equation (5);

$$POPI_{oil},a = PPLC \times 1n(LV_a + TD_a + TC_a) \quad (5)$$

(f) recording the calculated $POPI_{oil,a}$ values in a data set in conjunction with the position of the sample along interval L;

g) calculating the Apparent Water Saturation value, AS_w, from the POPI values in accordance with the following equations (10) and (11):

$$AS_o = (1-S_{wirr}) \times POPI_a \div POPI_{oil,a} \quad \text{and (10)}$$

$$AS_{W,a} = 1-AS_{o,a}. \quad (11)$$

h) recording the calculated AS_w values in a data set in conjunction with the position of the corresponding sample along the interval L; and

i) comparing the data set of conventional S_w values derived from the Archie Equation with the data set of AS_w values derived from the POPI values for a particular length along the interval L, whereby variations between the two data sets indicate changes in the character of the reservoir rock.

21. The method of claim 20, where the rock samples are rock cuttings.

22. The method of claim 20 where the values of the data sets are recorded in an electronic data storage device associated with a computer.

23. The method of claim 20 where the values of the data sets for S_w and AS_w are plotted graphically.

24. The method of claim 23 where the graphic plots are to the same linear scale along the interval L.

25. The method of claim 24 where the graphic plots are positioned proximate each other to facilitate the comparison.

26. The method of claim 25 which includes the further step of providing with the graphic plots of AS_w and S_w at least one other corresponding graphic plot of a data set from along the interval L selected from the group consisting of electric log data, lithofacies and Dean-Stark data.

27. The method of claim 20 where the known positions along the interval L are the depth below the earth's surface.

28. The method of claim 20 which includes recalibrating the exponential cementation values m and n for the Archie Equation (12):

$$S_w=(1/\phi^m \times R_w/R_t)^{1/n} \qquad (12)$$

where S_w is the water saturation,

ϕ is the porosity from electric logs,

m is the cementation exponent as determined from lab tests,

R_w is the formation water restivity as determined from electric logs or as determined by laboratory measurements of formation water samples,

R_t is the true resistivity of the formation as measured by deep investigation restivity tools, and

n is the saturation exponent as determined by lab tests, the method comprising the steps of:

a) applying at least one iterative change to the value of at least one of the exponents m and n;

b) recalculating the value of S_w from the Archie Equation;

c) recording the value of S_w obtained from step (b);

d) comparing the value of S_w recorded in step (c) to the value of AS_w;

e) repeating steps (a) through (d) above until the values of S_w closely match the values of AS_w.

29. The method of claim 28, where the value of both m and n are varied for at least one of the iterations.

30. The method of claim 28 where the value of S_w is recalculated at a plurality of locations along the interval L.

31. The method of claim 28 which comprises the further step of graphically plotting the values of AS_w and the recalculated S_w values to the same linear scale, whereby the relative matching of the values of AS_w and S_w is accomplished visually.

32. The method of claim 31 which comprises the step of providing with the graphic plots of AS_w and recalculated S_w at least one other corresponding graphic plot of a data set from along the interval L selected from the group consisting of electric log data, lithofacies and Dean-Stark data.